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ABSTRACT

The purpose of this study was to determine whether or not systematic verbal positive reinforcement administered by two relatively unsophisticated teachers would favorably affect students' achievement scores. Two kindergarten and two first grade classes served as the experimental population with ten students from each class and one teacher from each grade comprising the experimental group. All children were pre- and posttested on the Caldwell-Soule Preschool Inventory and the Peabody Picture Vocabulary Test (PPVT). Scores of the PPVT pretest and the Pintner-Cunningham (given to all kindergarten children) were held constant to control for intelligence differences. The experimental teachers were trained to administer appropriate positive reinforcement to their students. Study results showed that they considerably increased their positive reinforcement output from earlier baseline measures. The control teachers used positive reinforcement about as often as they had at baseline. Analysis of the Caldwell-Soule pre- and posttest scores revealed enough significant differences to support the contention that a program of systematic verbal positive reinforcement does favorably affect the achievement of kindergarten and first grade students. (MH)

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AN INVESTIGATION OF THE EFFECTS OF TEACHER VERBAL REINFORCEMENT[1] AS IT RELATES TO SCHOLASTIC APTITUDE AND ACHIEVEMENT WITH ELEMENTARY SCHOOL CHILDREN

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INTRODUCTION

The problem stated: Is there a relationship between adult (teacher) verbal reinforcement and the child's performance on an ability and achievement measure? The significance of the problem would tend to give educators and researchers yet another means to help describe the child and to demonstrate the effect of teacher reinforcement in this process.

Studies in adult social reinforcement of individual child behavior have shown that teacher attention used contingently is an effective stimulus in producing change in the child's behavior (1) (4) (7) (10) (11). These studies suggest that using attention effectively is a highly specialized skill. Previously the researchers involved in social reinforcement studies have been persons who had a competent understanding of the reinforcement process as well as experience in the practical application of social reinforcement.

This study would ask whether the behavior of a teacher who has had no training or study in the use of reinforcement principles could be modified to become similarly effective. Social attention can be an effective reinforcer as the studies referred to above have shown. This proposed study would use social attention as a reinforcer for teacher behavior. The particular teacher behavior to be studied is the teacher's systematic attention and positive reinforcement to child behavior during a semi-structured situation in an elementary school setting.

There are low achieving children for whom teacher attention is a powerful positive reinforcer, yet they have a low rate of productive classroom behavior. For these children a functional analysis may reveal that the attention contingencies are incorrect for maximum productivity; that teacher attention most often follows inappropriate behavior rather than productive academic behavior or other desired behavior; and that if this relationship were reversed, significant increases in academic productivity and other desired behavior could be achieved.

To date there has been very little systematic application of reinforcement principles to behavior problems or other kinds of modification in the regular classroom. Rather, extensive research has been carried out in laboratory preschools (1) (10) (11), in special classrooms (14) (9), and in institutional settings (3). However, there have been few attempts to devise methodologies which would be applicable to the public school classroom and which could be carried out by the classroom teacher. While this study did not specifically focus on behavior problems in the classroom, per se, it did appear that teacher attention did affect the children's behavior and functioning.

The end result of improving child behavior by adult attention or in some way, modifying it, should be ultimate improved school achievement

The Rosenthal study (12) has had an impact relative to the role of teacher behavior and its effects on the children. He found that teacher expectancies of children's behavior as measured by gain scores on an achievement test given pre and post, did have a significant influence over the year. The experimental teachers were told to expect unusual intellectual development from certain children (who were in fact, only randomly chosen). Teacher expectancies made the most difference in grades 1 (p .002) and grade 2 (.<02) on I.Q. gain. Because this tends to indicate the influential role of the teacher, the next step would seem to be to identify how such communication takes place--how teachers communicate their expectations to their pupils. It would seem logical that the results of the proposed classroom behavior modification could be reflected in terms of academic achievement by the utilization of the proposed instruments for this study. This might help describe what this teacher communication is, in part, that Rosenthal alludes to.

The basis for this proposed study was derived, for the most part, from Hall's (8) work in behavior modification through social reinforcement in the classroom. As the author had functioned previously in the public schools as a counselor and currently as a researcher, the potential findings of this study would seem to hold much promise for teachers and educators.

If teachers were trained to discover effective reinforcers for each child as well as to use those reinforcers effectively, an increase of that behavior in every child in that classroom would more likely occur. If refinements and adaptations of this proposed study would prove to be effective and efficient, it would seem that a useful means of training persons who work with children to become more discriminating and sensitive teachers could be developed.

To date there has been very little systematic application of reinforcement principles in the regular classroom. Becker (2) reported success in teaching teachers behavioral principles in college lectures and then having the teachers carry out behavior modification projects in their classrooms. As yet, however, there is very little published data which demonstrates the application of these behavioral techniques in public school settings.

The literature indicates the communality of these behavioral principles. Dixon (6) for example, found that disruptive behavior in a special class for incarcerated, delinquent, retardate boys could be controlled by the use of consumables (jelly beans) in a socially desired manner.

Zimmerman and Zimmerman (15) altered unproductive classroom behavior in two emotionally disturbed boys by removing the social consequences

of the behavior. Behavior which was more adequate and efficient with respect to social and scholastic adjustment was shaped and maintained with social reinforcers.

Wolf (14) likewise manipulated the consequences of the behavior of an autistic child and developed techniques for dealing with the subject's tantrums, sleeping problem, the establishment of wearing glasses and appropriate verbal and social behavior.

Allen (1) utilized positive social reinforcement with a nursery school child to establish effective play relations with his peers. The procedures involved only the presentation and withdrawal of positive reinforcement, the social reinforcer systematically manipulated being, adult attention.

Another study (5) found that a simple but consistent training procedure was effective in modifying teacher behavior in attending to children. Modification was effected when feedback was relevant indicating that social attention by itself did not produce modification of teacher attending behavior. Furthermore, there was evidence that relevant feedback consisting of information about both attended appropriate child responses and unattended child appropriate responses was more effective in training teachers than information about attended child responses by itself. Finally, there was evidence that the resultant modification represented increased activity in attending to appropriate child responses and did not reflect a higher rate of attending to all child responses in general.

A final pertinent study (8) conducted in a third-grade classroom gave promising evidence that a teacher can be taught to use reinforcement procedures to increase rates of study behavior. For example, one third-grade boy in a classroom of 40 pupils exhibited study behaviors in only 28 percent of the total number of ten second intervals sampled. His non-study behaviors included snapping bands, playing with toys, talking and laughing with peers and other such disruptive activities. He did not complete his work and spelled correctly only 40 percent to 80 percent of his weekly spelling test words. Continuous study rarely amounted to more than two or three one-minute episodes during any thirty-minute period.

After the teacher was instructed in how to use attention systematically as social reinforcement for studying, the child's rate of study climbed quickly and study behavior occurred in 79 percent of the ten-second intervals. As a result, the student began to finish his work without prompting and the amount of disruptive behavior dropped dramatically. His weekly spelling socre rose to 90 percent correct.

When the reinforcement procedures were discontinued for a short period, the frequency of study quickly dropped once more to a mean of 50 percent of the intervals (and was progressing downward). It rose to above 70 percent when systematic reinforcement was resumed. The implication of this as a demonstration that teachers can quickly learn to apply the procedures of positive reinforcement effectively shows great promise.

METHOD

Four classes were used in this study - two kindergarten classes and two first grade classes from the same school in a lower socio-economic area in a midwestern city.[2] Using a random procedure derived from Wert (13), random numbers were drawn until ten members from each class were included, making a total N of 40. However, two sample children moved away, so the total sample was 38. Two classes (one kindergarten and one first grade) were control classes and two classes were experimental.

The instruments used were the Preschool Inventory (Caldwell-Soule) which is an achievement measure, the Peabody Picture Vocabulary Test which is an ability measure, and the Pintner-Cunningham which is another ability measure which was administered to all children in kindergarten by the public school.

The Peabody Picture Vocabulary Test (Form B) and the Caldwell-Soule were administered in December, 1967, individually. After the pretesting was completed, the training and observation of the teachers began. The two experimental teachers (one first grade, one kindergarten) were trained to systematically administer reinforcement (both verbal and nonverbal)[3] to all children in her class by the trainer (the principal investigator). The control teachers received no instruction other than when the observer was to be scheduled in her class to take data. Baseline was taken on the four teachers to determine their rates of positive reinforcement. Observation was collected on the four teachers over twenty-four different days over sixteen weeks during a semistructured situation.

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The sample children were posttested in May, 1968, again with the Caldwell-Soule and the Peabody Picture Vocabulary Test - Form A. Results were then placed into a covariance design holding the Pintner-Cunningham and the Peabody pretest constant to investigate the treatment effects of teacher positive reinforcement with the dependent variable being the change in Caldwell-Soule scores.

RESULTS

In any analysis of variance, certain assumptions must be met. The same holds true for a multiple classification design. The assumptions are:

1. Homogeneity of variance

2. Means are independent

3. Variances are normally distributed

4. Samples are random

It was possible to effect a check for assumptions 1 and 4; thus these were met. Assumptions 2 and 3 were not met but by nature of the design of this study, were assumed to be met.

The rationale for a covariance design can be summed up in one question: Are the results obtained due to treatment or are the groups different to begin with?

The combined baseline rate for the two experimental teachers was 13 percent; for the control teachers, 3 percent. The rate of the two combined experimental teachers was 31 percent usage of positive reinforcement over the treatment period, the control teachers remained at 3 percent. The combined baseline rate for the experimental teachers was 20 percent; for the control, 3 percent.

INSERT FIGURE 1 ABOUT HERE

The data indicate that teachers can be trained to effectively use positive reinforcement with minimal preparation. The primary reason for the difference between the baseline rates of teacher reinforcement for the experimentals and the treatment day rates was due to the differences in time spent in observation. Also the fact that some activities are a lot more conducive to the administration of positive reinforcement than others is reflected in the day to day variance of the experimental teachers. The more unstructured the situation, the more likely the opportunity would be more opportune for the teacher to move about freely and interact. Treatment days 1 through 17 were based on fifteen minutes. Treatment days 18 through 22 were based on thirty minute units. The post-baseline was an attempt to investigate the carry-over effects of training over two or three hours in all aspects of the classroom (except recess), whereas the treatment days were usually fifteen to thirty minutes in length.

It should be apparent from the data on the graph that the experimental teachers did emit and sustain a significantly higher amount of positive reinforcement than the control teachers. Therefore, insofar as the data reflects how the teacher is functioning in her class, we can say that the treatment effects were operable χ^2 was computed in terms of observation data on teachers to investigate whether the

experimental teachers were interacting more with the sample children than the non-sample. χ^2 was not significant indicating that no preferential treatment was administered to the sample children. This tends to indicate that all children were treated equally insofar as teacher attention, interaction and positive reinforcement.

Table 1

FACTOR 1 - SUBTEST 1 CALDWELL-SOULE - PERSONAL-SOCIAL RESPONSIVENESS

Source of Variance	df	Sum of Squares	Mean Square	F
Treatment	1	.0905804	.0905804	.019942495
Grade	1	5.89410162	5.89410162	1.297665856
Interaction	1	.39548538	.39548538	.087071433
Within	32	145.3465473	4.542079603	
Total	35	151.7267147		

Relative to Factor 1 (Table 1), the F value of .019 for treatment effects is not significant. Therefore, is so far as change in Caldwell-Soule scores on Personal-Social Responsiveness (which is an attempt to try and get at knowledge about the child's own personal world and his ability to establish support with and respond to the communications of another adult) is controlled by pre Peabody Picture Vocabulary Scores and Pintner-Cunningham scores, the effectiveness of the treatment effects of reinforcement versus non-reinforcement cannot be proven unequal.

Likewise the F value of 1.29 for grade effect is non-significant. Therefore, under the same conditions as stated in the foregoing paragraph, no differences in Factor 1 scores could be demonstrated between students in the 1st grade or students in kindergarten as being a function of a grade difference.

Finally, the interaction effect of grade and treatment is also not significant on Factor 1. Therefore, under the same conditions as stated previously, the combination of grade and treatment effects did not result in any differences on the change in Factor 1 scores.

Table 2

FACTOR 2 - SUBTEST 2 CALDWELL-SOULE - ASSOCIATIVE VOCABULARY

Source of Variance	df	Sum of Squares	Mean Square	F
Treatment	1	17.9144059	17.9144059	2.113257366
Grade	1	21.2872369	21.2872369	2.511130452
Interaction	1	9.7709627	9.7709627	1.152623147
Within	32	271.268894	8.477152937	
Total	35	320.2414349		

Table 2 lists the results of the change in associative vocabulary. This subtest tries to get at a functional awareness of a word by carrying out some action or associating to certain qualities of the verbal concept. All three F values on treatment, grade and interaction effects are not significant. Therefore, in so far as change in Caldwell-Soule scores on associative vocabulary is controlled by Peabody and Pintner-Cunningham scores, the effectiveness of the treatment effects of reinforcement versus non-reinforcement, a systematic grade difference, or a combination of these two, cannot be proven unequal.

Table 3

FACTOR 3 - SUBTEST 3 CALDWELL-SOULE - CONCEPT ACTIVATION - NUMERICAL

Source of Variance	df	Sum of Squares	Mean Squares	F
Treatment	1	25.8310646	25.8310646	8.816627418**
Grade	1	3.554411377	3.554411377	1.213187351
Interaction	1	34.47035462	34.47035462	11.765379335**
Within	32	93.75399761	2.929812425	
Total	35	157.6098282		

** $p < .01$

Adjustment of Mean Scores

		N	
Treatment	Factor 3	20	2.3432224
Control		18	.7350574

Table 3 lists the results of the change in numerical relations. This subtest tries to measure ordinal or numerical relations. The F value of 8.81 for treatment effect is significant. Thus when individual differences on two ability measures were controlled, evidence exists that having or not having a treatment of systematic positive reinforcement influences the gains made on Factor 3 of the Caldwell-Soule. Since this F value was significant, an adjustment of the means is in order to reflect the influence of the predictors. The mean change score on Factor 3 for the treatment group was increased +.04; for the controls, -.04. This would indicate that intelligence seems to have little effect on the treatment outcome.

The grade effect relative to Factor 3 is not significant. Therefore, insofar as change in Factor 3 scores are controlled by Peabody and Pintner-Cunningham scores, the difference due to grade effect, has not been found.

The F value for the interaction effect of grade and treatment is 11.76 which is significant. To account for this significance, one should look at the mean change scores. The respective gains for the two experimental teachers were 1.4 and 3.4 raw score points while the change effects for the controls were +1.77 and -.22 raw score points. Thus we can see where the one control teacher accounts for the differences being significant. Therefore, under the same conditions as stated previously, the combination of grade and treatment effects did influence the change in Factor 3 scores.

Table 4

FACTOR 4 - SUBTEST 4 CALDWELL-SOULE - CONCEPT ACTIVATION - SENSORY

Source of Variance	df	Sum of Squares	Mean Square	F
Treatment	1	1.2377995	1.2377995	.468892877
Grade	1	18.6820878	18.6820878	7.076992597*
Interaction	1	4.92704925	4.92704925	1.866423683
Within	32	84.47469745	2.639834295	
Total	35	109.321634		*p<.05

Adjustment of Mean Scores

		N	
Grade - K	Factor 4	19	1.6098633
Grade - 1st		19	.229645

Factor 4 relates to the sensory aspects of being able to describe form, color, size, shape and motion. Table 4 lists the results of the change on the sensory subtest.

The F value of .46 for treatment effect is not significant. Therefore, insofar as change in Factor 4 scores are controlled by Peabody and Pintner-Cunningham scores, the difference due to treatment effect has not been found.

The grade effect F-ratio on this subtest is significant. This can be explained by the fact that the first graders already possess this ability for the most part and the kindergarteners acquire the skills needed for this factor during the school year. This subtest is not too suitable for the first grade but does seem to reflect gains made in kindergarten. Again, adjusting the means to reflect the influence of the predictors results in a loss of .07 for the kindergarten group and a gain of +.07 for the first grade group. It would seem that intelligence seems to have minimal effect on the outcome.

The interaction effect of grade and treatment on Factor 4 is non-significant. Therefore, under the same conditions as stated previously, the combination of grade and treatment effects did not result in any differences on the change in Factor 4 scores.

Table 5

FACTOR 5 - TOTAL CALDWELL-SOULE SCORE (SUBTESTS 1-4)

Source of Variance	df	Sum of Squares	Mean Square	F
Treatment	1	109.0414878	109.0414878	5.36208559*
Grade	1	2.9725664	2.9725664	.146175146
Interaction	1	23.992366	23.992366	1.179818094
Within	32	650.7407504	20.33564845	
Total	35	786.7471706		*p<.05

Adjustment of Mean Scores

		N	
Treatment	Total Scores	20	6.99618658
Control		18	3.8567

Table 5 shows the composite gain score on tests one through four of the Caldwell-Soule. The F value of 5.362 for treatment effects is significant. Therefore, when individual differences on two ability measures were controlled, evidence exists that having or not having a treatment of systematic positive reinforcement influences the total gains made on the Caldwell-Soule. An adjustment of the means to reflect the influence of the predictors of +.04 for the treatment groups and -.04 for the control group again points out the minimal effect of intelligence on the total outcome.

No grade bias exists on the total change score as evidenced by the non-significant F ratio. And a combination of treatment and grade effects does likewise not result in any systematic differences. Therefore, under the same conditions as stated previously, the combination of grade and treatment effects did not result in any differences on the change in total Caldwell-Soule scores.

To summarize, the treatment effects of positive reinforcement are significant in and of themselves; intelligence seems to have no effect on the result.

DISCUSSION

It seems apparent from the data that two conclusions can be tentatively posed:

1. Teachers can be trained to effectively use verbal positive reinforcement. The training of any subsequent teacher, therefore, would seem to pose no real problem for replication.

2. Achievement of gains were such that something other than chance was operative to bring about these changes.

LIMITATIONS

1. Sample size was a definite limitation. It would have been much better to have tested the effect of positive reinforcment on the entire class, rather than on one-third of them.

2. Teacher sophistication relative to the two control teachers. There was no way to control the interchange of information among the four teachers. This could have produced a bias but the data seems to indicate that this was not operative.

3. A last limitation was the assumption that the observation period represented how the teacher did typically interact with her class. The length of the baseline time over two hours and the last five observational days was an attempt to get a better description of the teacher. However, by limiting the observational unit to a situation where the teacher is more or less free to interact with whom she wants, which was the original intent of this study, answers the criticism at this point.

4. Observing conditions (subjectively) were not the same in the kindergarten and first grade classes. The two kindergarten classes were equivalent for observation; the two first grade classes were also equivalent to each other. However, the conditions were not the same across grades.

The first grade classes were more structured (by definition). The experimental first grade teacher was (subjectively, on the authors part) much less structured than the control first. None of the data can prove or disprove this assumption. Free-play in the first grade (or free choice of activity) is a near impossibility. In one sense, there are almost two different studies--the only commonalty being the systematic use of positive reinforcement.

An example--the first grade control teacher was at all times in complete control and direction of her class. The children had a free-choice only in the respect of activities, usually three or four prescribed by the teacher. The teacher would more likely than not be in covert control of all the "free choice" activities and would actively participate in the activities.

Contrast this with the kindergarten control teacher: She would typically interact quite minimally with the children, allowing them to choose their activities and utilize the free-play period for setting up materials relative to subsequent afternoon activities.

The experimental first grade teacher (as instructed) would typically interact with her class in a similar structured situation--i.e., all the class would be working on creative arts and she would allow the children to interact with each other. There was structure in that the class would be doing the same thing at the same time.

The experimental kindergarten teacher could be described as being quite similar to the control K. The biggest distinction was primarily in terms of interaction with the children.

Baseline times were not equal on each teacher. It was not possible to equate the times across the teachers. The kindergarten programs were half-day; first grade was a full-day program.

One relevant issue of the interaction process is how much generalizibility (or transfer effects) can be expressed in positive reinforcement by the teacher to her class. It is imperative that this issue be further investigated and researched. This study indicates that the transfer effects, to some extent, are happening. But due to the chance or unexplained factors which are operative, better control of these factors must be accounted for.

Another germane and related issue which contributed to the error variance was the role of the non-sample children. Obviously, since chi-square was not significant relative to teacher interaction, these children were being influenced in the same way as the sample children. Coupled with the fact of individual differences in each class, a real possibility exists that this program of positive reinforcement will not work equally as well across all ability levels. This is another area for needed investigation.

A further extension of this study in 1968-69 will be carried out in two Head Start classrooms, involving all children in each class using four cognitive variables.

SUMMARY

Two first grade and two kindergarten classes were randomly selected to test the hypothesis of whether or not a program of systematic positive reinforcement would have an effect on achievement gains as measured by the Caldwell-Soule over six months, holding pre Peabody Picture Vocabulary Test scores and Pintner-Cunningham scores constant.

Ten children were randomly selected from each class with one first grade teacher and one kindergarten teacher being designated as experimental teachers paired with one first grade control teacher and one kindergarten control teacher.

The experimental teachers were trained to administer positive reinforcement to all members of their classes and increased from 13 to 20 percent over the duration of the study; the two control teachers remained at 3 percent from pre-baseline to post-baseline on the positive reinforcement variable.

Four significant F ratios were found in terms of gains on the Caldwell-Soule. Factor 3, numerical, was found to be significant beyond the .01 level relative to the treatment effects, indicating

that a program of systematic positive reinforcement does seem to have an effect on the gains made. The interaction F ratio was also significant beyond .01 on this factor, indicating that a grade and treatment combination has an effect on gains made.

Factor 4 (sensory) had one significance at the .05 level. There was a grade difference found which indicated a limitation on the subtest - most first graders already had the necessary skills for this factor.

The total Caldwell-Soule gain score was significant beyond the .05 level for the treatment group again indicating that a program of systematic positive reinforcement does seem to have an effect on the gains made in achievement.

The adjustment of means to reflect the influence of the predictors was very minimal so one can conclude that the treatment effects are significant in and of themselves and that intelligence has no effect on the outcome.

This study found that a program of systematic teacher positive reinforcement does have an effect on the gains made on an achievement measure. More research is needed as well as refinements in the techniques utilized to further investigate this important variable.

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FOOTNOTES

[1]The research reported herin was performed pursuant to a contract with the Office of Economic Opportunity, Executive Office of the President, Washington, D. C. 20506. The opinions expressed are those of the author and should not be construed as representing the opinions or policy of any agency of the United States Government.

[2]The author wishes to thank the four cooperating teachers, the principal and the administrative personnel of the school for their help during this study. Other thanks go to Graeme Blasdel, Joan Blasdel, Cathy Silver, Ann Kugler and Correl Robinson of the University of Kansas Head Start Evaluation and Research Center staff for their assistance as testers and observers.

[3]Definitions of Positive Reinforcement:

Verbal Reinforcement

1. Praising the child for attending to work behaviors which are ongoing or completed:

   EXAMPLES: Ongoing - Teacher comments, "I like the way you are making your letters." "I like the way Billy is reading his book." "Good." "Fine."

   Completed - After child has finished his art work the teacher says, "That was a very good valentine you made."

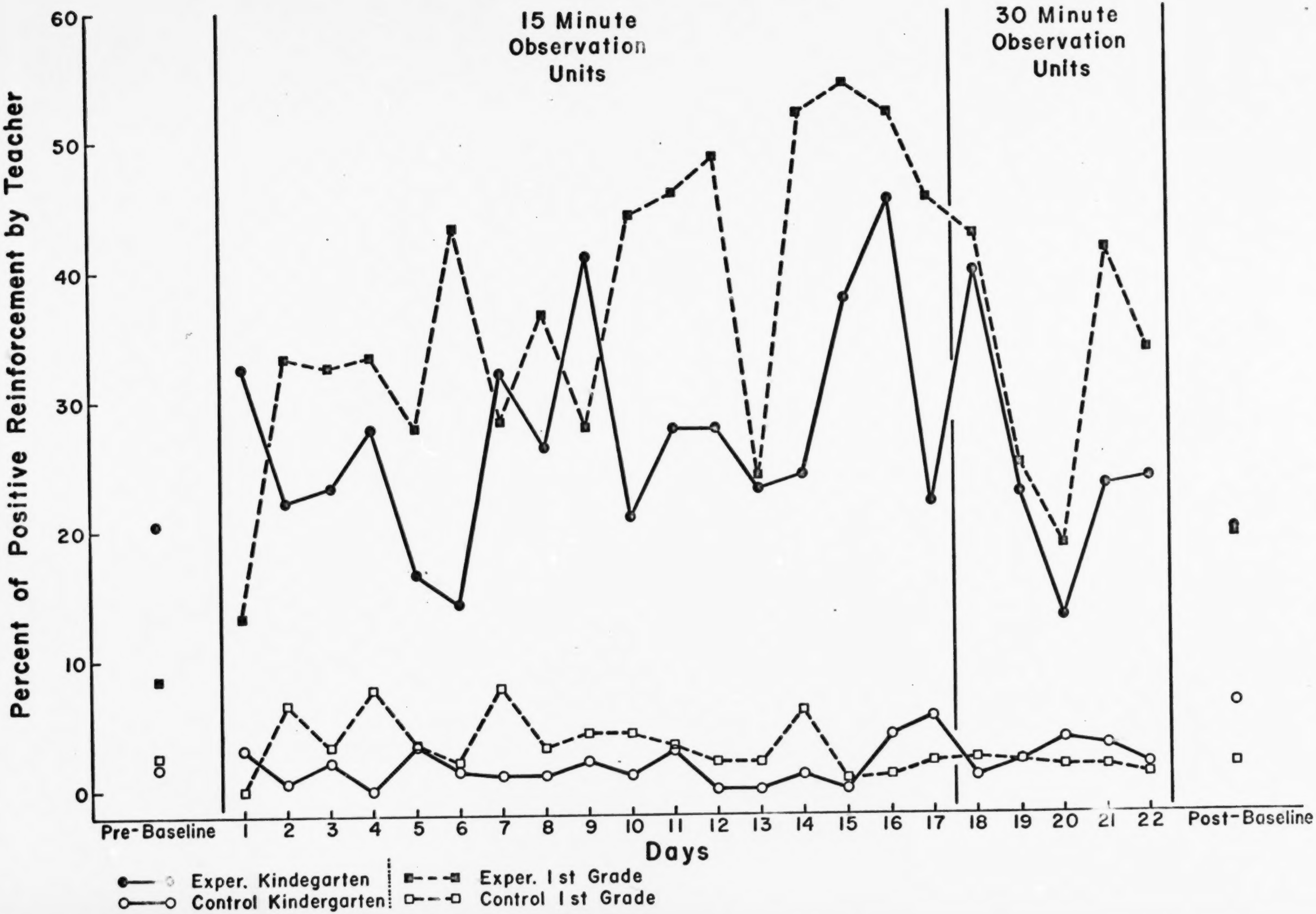
2. Reinforcing the child when he follows the teacher's directions:

   EXAMPLE: "Thank you for getting the water Susie."

Nonverbal Reinforcement

This is a rather limited category--confining it to a physical hug by the teacher or a teacher's touch when it is paired with positive verbal reinforcement. Smiling by the teacher would not be coded as nonverbal reinforcement unless it was paired with other behaviors defined as reinforcing.

Figure 1. Behavior curves of reinforcements by the two control and two experimental teachers. Pre and post baseline curves are graphed on the basis of one day for the four teachers. Days one through seventeen are based on a minimum of fifteen minutes; days eighteen through twenty-two are based on thirty minutes.


15 Minute Observation Units
30 Minute Observation Units
Percent of Positive Reinforcement by Teacher
60
50
40
30
20
10
0
Pre-Baseline
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22
Post-Baseline
Days
Exper. Kindegarten
Control Kindergarten
Exper. 1st Grade
Control 1st Grade